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Regional Differences in Harvesting Levels and Wood-Based Employment in Norway

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In this paper, a statistical framework based upon shift-share analysis is employed to analyse regional differences in Norway regarding changes in harvesting levels and number of full-time equivalent employees in wood processing. Changes in harvesting levels and employment differ between regions. A tendency found is that there has been a moderate centralisation in the period 1990-2000 with respect to harvesting levels. The analysis indicates that remote municipalities harvest relatively more in periods with a high harvesting intensity, while the harvesting level is more evenly distributed among the regions in other periods. There is, however, no clear picture whether there has been a centralisation or decentralisation regarding wood-based employment. Differences between regions may therefore be explained by structural factors, for example the degree to which firms in a particular region concentrate on production of bulky commodities or more customer-oriented niche production.

Keywords: regional analysis, shift-share analysis, wood manufacturing

INTRODUCTION

Forest production provides a basis for employment in wood processing industries, and the mutual independence of the forest-based industries is important for income and employment in many rural regions (Marcouiller *et al.* 1995, Marcouiller *et al*. 1996, Stier *et al*. 1999). Therefore, developing the forest sector has been put forward as a mean to support rural development (Koch and Rasmussen 1998, Hyttinen *et al.* 2002). If a rural region succeeds in developing competitive wood manufacturing industries, it is supposed that a greater utilisation of the forest resources will follow, for example by an increased rate of harvesting.

Due to globalisation and changing market conditions, wood processing and manufacturing has during the past few decades faced a huge restructuring. These transitions have affected different regions in various ways, and possible development paths of the industrial restructuring can therefore also be explained in various ways (e.g. see Tykkyläinen *et al.* 1997 for a review of theories of regional development with relevance to the forest sector). In Norway, as well as in many other countries, it is supposed that the restructuring of the wood manufacturing industries has caused a concentration of activities due to mergers and shutdowns.

One possible consequence of industrial concentration and centralisation is a corresponding concentration and centralisation of harvesting and other forest-related activities. This occurs partly because of increased transportation costs due to larger procurement areas. In turn, this may work in the direction of reducing the prices of timber in the fringes of these areas. Consequently, this may depress harvesting levels in some regions or even make them non-viable for commercial forestry. Another consequence of industrial concentration is that it reduces spatial competition (Greenhut *et al.* 1987), which may further reduce the level of timber prices in industrially remote regions.

Reduced activities in some regions will create opportunities for increased harvesting in regions surrounding the concentrated industry. However, it will not be particularly feasible to counteract reduced harvesting in industry remote areas through increased harvesting in central areas. These already have a relatively high degree of forest utilisation, and at the same time the level of conflict between commercial and multiple-use forestry is more intense. Eventually, the result is a decline in timber cut at the national level, increased imports and a reduction of the overall economic contribution from the forest sector. This has been the case in Norway, where the forestry and forest industries share of GDP declined from 4.1% to 1.5% and the share of total employment from 5.1% to 1.6% over the period 1962-2001 (Størdal 2002). To illustrate the relatively dramatic shift recently, Norway experienced a near 30% decline of the total domestic cut in the period 1990-2000.

Centralisation of the industry followed by a centralisation of harvesting might be worrying from a policy point of view because utilisation of forest resources is of greater importance in rural areas in which there is relatively low access to alternative employment, and few other alternative sources of income. However, it is not necessarily the case that concentration and centralisation of wood manufacturing industries means centralisation of harvesting or other forestry related activities. Nor do abundant timber resources as such create employment. This is illustrated for example by the substantial growth of the Danish wood furniture industry during the last decades, as contrasted with the static situation in Finland in spite of a bounteous supply of high-quality timber (Maskell *et al.* 1998). The effects of concentration in the manufacturing industries on harvesting levels are therefore somewhat ambiguous. Gaining knowledge of important effects from concentration is crucial in order to determine policy measures for rural development based on the forest resources.

The objectives of this paper are therefore: (a) to analyse whether there has been a centralisation of employment in the wood processing industry and the harvesting levels in Norway recent decades, and (b) if so, whether the restructuring processes are corresponding, and, finally, as a supplementary objective, (c) to determine what types of regions are most sensitive to national level changes in employment and harvesting.

The next section reviews recent developments in the Norwegian forest sector. The method of analysis applied in this study is then outlined and discussed, and data sources outlined. Finally, the results of the analysis are presented and discussed.

THE NORWEGIAN FOREST SECTOR

Even though the importance of forest-based activities in Norway has declined over the last few decades, forest operations and wood processing continue to be important for employment and income generation in a number of rural districts. This is especially so if account is taken of the spin-off effects the activities have by way of subcontracts.

The forest industry is represented in most municipalities. In 2001, manufacturing of wood products was conducted in 317 of the country's 434 municipalities, while pulp and paper production was present in 56 municipalities. The distribution is however uneven. Ørbeck *et al.* (1998) calculated localisation quotients[1] (LQs) based on forest industry employment and harvesting for various territorial regions in Norway (Figure 1). As illustrated, forest-based production is of greatest importance in Eastern Norway, Trøndelag, and to some degree in Southern Norway.

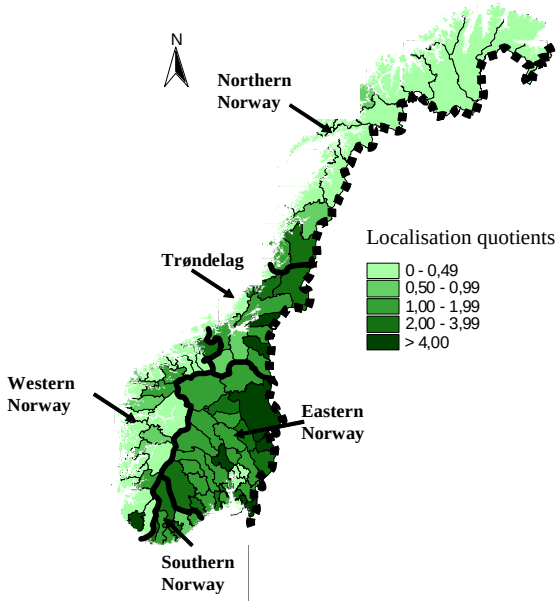

Figure 1. Localisation quotients, Norwegian forest industries, 1995 (Ørbeck *et al.* 1998)

[1] The localisation quotient at point of time *t* for industry *i* in region *r* is defined as

$$LQ_{rit} = \frac{E_{irt} / P_{rt}}{E_{it} / P_{t}}$$

where E_{ir} represents employment in industry *i* in region *r* and P_r the total employment in region *r*. E_i represents employment in industry *i* on the national level and P total overall employment. An LQ value of 1 indicates that the industry has the same representation (or importance) in the particular region as nationally. An LQ>1 (<1) implies that the industry is relatively more (less) important in the region than nationally.

In line with the developments internationally, the employment level in wood processing (defined as NACE[2] 20) in Norway has declined in recent decades. Employment in 1980 amounted to 24,521 full-time worker equivalents, falling by the year 2000 by 40% to 14,634 units (Figure 2).

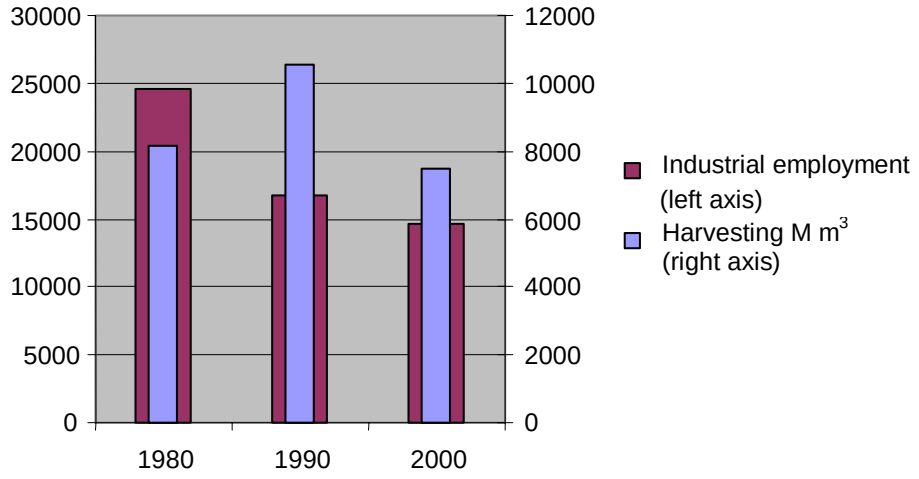

Figure 2. Industrial employment in wood manufacturing (NACE 20) and harvesting levels in Norway, 1980, 1990, and 2000
Source: Statistics Norway (2002a, 2002b).

Figure 2 also reveals that the 1980s represented an upswing in harvesting for industrial purposes, while the 1990s represented a downswing. Harvest quantity increased by 29% to 10.53 M m^3 in the period 1980-1990, declining to 7.48 M m^3 by 2000. This contrasts with the trend in the neighboring countries of Sweden and Finland, where harvested volume has increased in spite of the concentration in the forest industry (Figure 3).

[2] The European Union's standard industrial classification "Nomenclature statistique des Activités économiques dans la Communauté Européenne", as described in http://forum.europa.eu.int/ irc/dsis/coded/ info/data/coded/en/gl006813.htm

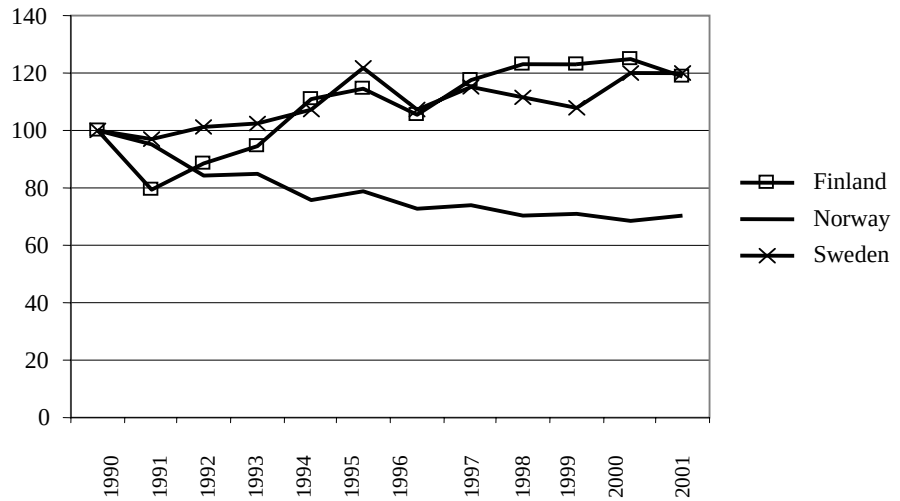

Figure 3. Development in the harvesting levels in Norway 1990-2001 compared to Finland and Sweden (Indexed: 1990=100)
Source: FAOSTAT (2003).

Beyond the national figures, there are large regional differences, both with respect to the level of harvesting and employment in wood processing and to their relative importance for the various regions. Ørbeck *et al.* (1998) concluded, for example, that the decline in employment in wood processing had a greater negative impact on total industrial employment and income in rural regions than urban or central regions, due to the greater relative importance of forest industries in these regions.

The recent progress of the forest-based industries in Norway seems to have been far weaker than for example in Sweden and Finland. Both the level of wood-based employment and the harvesting level have declined. Reduced domestic harvesting has to some extent been replaced by imported timber (Størdal 2002), but also the total domestic production of lumber has declined. These changes may have consequences for income, employment and – in the longer term – the size of population in many rural districts where the forest sector traditionally has held a strong position.

THE SHIFT-SHARE ANALYSIS

The patterns of harvesting levels and wood-based employment between regions may be viewed in either relative or absolute terms. By examining changes in absolute values, the results will be biased towards large regions, even though these may have had a slower rate of growth than other regions. When considering only relative changes, the results will be biased towards regions categorised as marginal, and therefore of little interest. One way to combine relative and absolute changes is to perform a shift-share analysis (Houston 1967, Stevens and Moore 1980). This involves breaking down changes into two components. A *structure component* reveals how large the change in absolute values would have been if harvesting levels

or wood-based employment in the specific region had the same relative change as the national average (and can thus be denoted as the expected change). The second component is denoted the *shift component*, which is the deviation between observed change in absolute value, and the structure component. These components can be defined as follows:

$$\underbrace{e_{1i} - e_{0i}}_{\text{observed change}} = \underbrace{e_{0i}\frac{e_1}{e_0} - e_{0i}}_{\text{structure component}} + \underbrace{\left[\left(e_{1i} - e_{0i}\right) - \left(e_{0i}\frac{e_1}{e_0} - e_{0i}\right)\right]}_{\text{shift component}} \qquad (1)$$

where e_{0i} and e_0 are initial (time 0) harvesting levels (or wood-based employment) in region *i* and at the national level respectively; e_{1i} and e_1 are harvesting levels (or wood-based employment) at time 1 in region *i* and at the national level respectively.

With an exception of Bilek and Ellefson (1984), the shift-share technique has, to the best of our knowledge, not been applied extensively to changes in regional employment patterns in forest industries. This is rather strange, even though the technique has been criticised because it is based on simple assumptions. For example, it assumes that the regions have the same technology, and that they face the same demand, i.e. that the goods are traded in the same (national) market. Another criticism of this technique is that it is rather atheoretic, i.e. not based on economic theory (Houston 1967). However, as pointed out by Bivand (1999), shift-share analysis has proved capable of drawing attention to interesting tendencies and has therefore been used extensively to describe differences in the patterns of regional growth.

Fingleton (1994) fitted dummy variables to test for differences in the shift coefficient over regions. His methodology is modified in this paper in order to detect similarities between those regions that have experienced the same development in terms of the shift component. This means arranging equation (1) into a regression model where observed change is the dependent variable, the structure component is the explanatory variable and the shift coefficient is a residual:

$$\left(e_{1i} - e_{0i}\right) = \alpha_0 + \alpha_1\left(e_{0i}\frac{e_1}{e_0} - e_{0i}\right) + \mu_i \qquad (2)$$

Both the observed change and the structure component in each region are calculated before estimation. By restricting the coefficients α_0 to zero and α_1 to unity, the residuals, μ_i, from this restricted regression will equate to the shift component from region *i*. Since the regression coefficient values are established *a priori*, estimation bias is avoided (Fingleton 1994). A test for whether changes can be explained geographically, either by territory or by centrality, can be carried out by adding dummy variables to equation (2). These variables will capture variation in the residuals (which equates to the shift component) due to variations geographically. Possible systematic variations can, thus, be verified statistically.

In many analyses the interest is in examining changes over differing time spans. In this paper, the question whether particular regions develop different from the national average in a period of recession relative to a period of growth, is tested.

SOURCES OF DATA ON HARVESTING LEVELS AND EMPLOYMENT IN WOOD PROCESSING

Data for the shift-share analysis were extracted from Statistics Norway's manufacturing statistics (Statistics Norway 2002a) and forestry statistics (Statistics Norway 2002b) for the years 1980, 1990 and 2000. These data include harvest volume (m^3) and employment (full-time worker equivalents) in wood processing (NACE 20) for all 434 municipalities. The rationale for choosing employment is that employment is probably the most critical individual indicator in any assessment of wood processing's regional role. Equally important is the fact that few other relevant variables are available at municipal and regional level.

Data were grouped according to five territorial regions, namely *Eastern Norway* Code=1), *Southern Norway* (Code=2), *Western Norway* (Code=3), *Trøndelag* (Code=4) and *Northern Norway* (Code=5). These were almost in accordance with the NUTS 2 definition[3]. The municipalities were also divided according to centrality as defined by Statistics Norway (1999). Centrality is defined here as a municipality's position with respect to a centre with so-called central functions (normally a city). There are four main levels of centrality according to distance to the centres (Statistics Norway 1999): *Central municipalities* (Code=3), *Fairly central municipalities* (Code=2), *Fairly remote municipalities* (Code=1), and *Remote municipalities* (Code=0).

RESULTS OF SHIFT-SHARE ANALYSIS

Shift-share analysis was used to define winner (positive shift coefficient) and loser (negative shift coefficient) regions, i.e. regions having a different development than the national average. The shift coefficients were initially tested for difference from zero at various significance levels. As revealed in the results from restricted OLS regression in Table 1, which reports result from the shift-share analysis regressions (cf. equation 2), centrality seems to be a better indicator for winner and loser regions with respect to harvesting than territory.

[3] Nomenclature des Unités Territoriales Statistiques (Nomenclature of Territorial Units for Statistics). Eurostats uniform breakdown of territorial units for the production of regional statistics for the European Union, cf. http://europa.eu.int/comm/eurostat/ramon/nuts/introduction_regions_en.html

Table 1. Shift coefficients for harvesting levels and wood-based employment Municipalities grouped after centrality (S) and territory (L) for the period 1980-1990 and 1990-2000.

Dummy coefficient	Number of observations	Shift coefficient, harvesting level		Shift coefficient, wood based employment	
		1980-1990	1990-2000	1980-1990	1990-2000
S0	203	1907*	-433	1.57	1.81
		(1038)	(511)	(2.33)	(2.37)
S1	46	3855*	2129**	5.50	3.66
		(2180)	(1073)	(4.89)	(4.98)
S2	81	-4431***	451	1.11	-9.54**
		(1643)	(809)	(3.69)	(3.76)
S3	104	-1975	-449	-6.37*	2.27
		(1450)	(714)	(3.25)	(3.32)
L1	142	-1596	892	1.35	-10.08***
		(1259)	(612)	(2.79)	(2.78)
L2	56	144	632	2.65	14.01***
		(2005)	(974)	(4.44)	(4.43)
L3	98	1046	-517	1.96	5.27
		(1516)	(736)	(3.36)	(3.35)
L4	49	2699	-1187	-9.11*	2.29
		(2144)	(1041)	(4.75)	(4.74)
L5	89	-181	-598	-0.97	0.20
		(1591)	(773)	(3.52)	(3.52)

***p<0.01, **p<0.05, *p<0.1
Standard deviations are shown in parentheses.

Remote municipalities (S0 and S1) were winners, while Fairly central municipalities (S2) where losing during the 1980s, where the national harvesting level experienced an upswing. In the period 1990-2000, Fairly remote municipalities were still winners; however, there was a tendency of centralisation. The shift coefficient decreased in Remote municipalities, while increasing in Central and Fairly central municipalities (S2 and S3). None of the shift coefficients for territorial regions were different from zero at a 10% significance level.

Central municipalities (S3) lost, when it comes to wood-based employment, in the period 1980-1990, while Fairly central municipalities (S2) lost in the period 1990-2000. No territorial regions could be deemed winners at a 10% significance level. Trøndelag (L4) lost employment relative to the other regions during the 1980s, while municipalities in Eastern Norway (L1) lost and Southern Norway regions (L2) won in the period 1990-2000.

Tables 2 and 3 illustrate which regions lost and won when looking at centrality within the different territorial regions. Remote municipalities won, and central municipalities lost, with respect to harvesting levels during the upswing period from 1980-1990 in Eastern Norway (L1). On the other hand, Fairly central municipalities

lost in Southern Norway (L2), while Central municipalities won in Trøndelag (L4). Considering wood-based employment, Fairly remote municipalities won in Southern Norway, but lost in Trøndelag. Central municipalities lost in both Trøndelag and Northern Norway (L5).

Table 2. Restricted OLS regressions for the period 1980-1990, with interaction dummies for territory (L) and centrality (S)[a]

Centrality	Territory				
	L1	L2	L3	L4	L5
S0	+/0	0/0	0/0	0/0	0/0
S1	+/0	0/+	0/0	0/-	0/0
S2	-/0	-/0	0/0		0/0
S3	-/0	0/0	0/0	+/-	0/-

+ = Significant increase in the shift coefficient at 10% significance level
- = Significant decrease in the shift coefficient at 10% significance level
[a] Figures at the left-hand side of the slash relates to harvesting levels, while figures at the right-hand side relate to wood-based employment.

Table 3. Restricted OLS regressions for the period 1990-2000, with interaction dummies for territory (L) and centrality (S)[a]

Centrality	Territory				
	L1	L2	L3	L4	L5
S0	0/0	0/0	0/0	0/0	0/0
S1	+/0	0/+	0/0	0/0	0/0
S2	0/-	0/0	0/0		0/0
S3	0/-	0/+	0/0	0/0	0/0

+ = Significant increase in the shift coefficient at 10% significance level
- = Significant decrease in the shift coefficient at 10% significance level
[a] Figures at the left-hand side of the slash relates to harvesting levels, while figures at the right-hand side relate to wood-based employment.

In the period 1990-2000, Fairly remote municipalities were still on the top of the 'winner-list' with respect harvesting in Eastern Norway. Central municipalities were losers when it comes to wood-based employment in Eastern Norway, while Fairly remote and Central municipalities won in Southern Norway.

Summing up, two categories of regions distinguish themselves as winners in both time periods, namely Fairly remote municipalities in Eastern Norway (harvesting), and Fairly remote municipalities in Southern Norway (employment in wood processing).

Next the direction of tendencies – i.e. whether the regions have become more or less winners or losers – was tested between the two time periods. The null hypotheses for all tests were that there has been no change in the shift coefficient between the two periods of time.

Table 4. Tests of change in shift coefficients from 1980-1990 to 1990-2000 with respect to centrality (S) and territory (L)

Centrality(S) and Territory(L)	Number of observations	Shift coefficient for harvesting level			Shift coefficient for wood-based employment		
		1980-1990	1990-2000	F-test	1980-1990	1990-2000	F-test
S0	203	1906.6	-432.6	11.07***	1.57	1.81	0.03
S1	46	3855.4	2128.8	0.50	5.50	3.66	0.05
S2	81	-4431.4	451.4	2.61	1.11	-9.54	2.24
S3	104	-1975.5	-448.76	1.19	-6.37	2.27	1.88
L1	142	-1596.7	892.2	1.16	1.35	-10.08	6.15**
L2	56	144.0	631.7	0.16	2.65	14.00	1.11
L3	98	1046.4	-516.7	34.23***	1.96	5.27	1.79
L4	49	2699.0	-1187.2	6.60**	-9.11	2.29	4.11**
L5	89	-181.16	-598.42	0.70	-0.97	0.20	0.35

***p<0.01, **p<0.05, *p<0.1

As indicated in Table 4, three categories of regions had a negative development of the shift coefficient from the 1980s to the 1900s with respect to harvesting, namely Remote municipalities, and the two territorial regions Western Norway (L3) and Trøndelag (L4) (cf. table 4). In terms of employment in wood processing Eastern Norway (L1) had negative development, while Trøndelag increased its shift coefficient significantly.

Table 5 illustrates the direction of shift coefficient between the two time periods when geographical regions are coupled with functional regions. The shift coefficients changed negatively with respect to harvesting for remote regions in Eastern and Western Norway and Trøndelag as well as Fairly central municipalities in Western Norway. A positive shift occurred in Central municipalities in Eastern Norway and Fairly central municipalities in Southern Norway. In relation to industrial employment, the shift coefficient decreased in Fairly central municipalities in Eastern Norway, while it increased in Central municipalities in Trøndelag and Fairly central municipalities in Northern Norway.

Table 5. Tests of change in shift coefficients from 1980-1990 to 1990-2000 with respect to both centrality (S) and territory (L)[a].

Centrality	Territory				
	L1	L2	L3	L4	L5
S0	-/0	0/0	-/0	-/0	0/0
S1	0/0	0/0	0/0	0/0	0/0
S2	0/-	+/0	-/0		0/+
S3	+/0	0/0	0/0	0/+	0/0

+ = Significant increase in the shift coefficient at 10% significance level

- = Significant decrease in the shift coefficient at 10% significance level

[a] Figures at the left side of the slash relate to harvesting levels, while figures at the right side relate to wood-based employment

DISCUSSION

The questions raised in this paper have been whether the levels of harvesting and industrial employment in Norway have experienced a centralisation in recent decades, whether the development paths of these have been corresponding, and which type of regions have responded most to national level changes.

A tendency found is that while there has been a moderate centralisation in the period 1990-2000 with respect to harvesting levels, the findings are more ambiguous when it comes to industrial employment. These findings are somewhat surprising, but can be to some extent explained.

Timber harvesting levels in Norway experienced an upswing during the 1980s and a recession during the 1990s. The application of shift-share analysis reveals, at the national level, that Remote municipalities (S1) have been the 'winners' in the upswing, while the picture seems to be more nuanced in the recession period 1990-2000. These pictures are clearer for Eastern Norway (L1) where Remote municipalities have a negative tendency, while Central municipalities (S3) have a positive tendency, with respect to the shift coefficient for harvesting levels. One may therefore conclude that Remote municipalities experience relatively higher harvesting levels in 'boom' periods while these are more evenly distributed between central and remote regions when the total harvesting levels are declining. The question left for future research is why the harvesting levels in Remote municipalities seem to be more volatile.

The level of industrial employment provides no clear picture of a centralisation or decentralisation. The exception is Eastern Norway where both Central and Fairly central municipalities have experienced a downswing, and Southern Norway where Central municipalities have had an upswing in employment. A possible reason for such diverging results is that production of standard products has been centralised due to economics of scale, but this centralisation has in turn paved the way for more customer-oriented and labour-intensive niche production in remote regions. Moreover, the development in different regions can be ascribed to various reasons, for example differences in the business environment.

The tendencies identified in this paper are not conclusive and an unambiguous inference cannot be drawn. However, an interesting though cautious policy implication of this study is that there is not necessarily a relationship between the patterns of change in harvesting levels and industrial employment. Thus, access to natural resources is not necessarily crucial to a region's progress related to wood-based activities.

This study has utilised the shift-share technique, a well-known method in regional analyses, which is capable of detecting interesting tendencies and differences in the patterns of regional growth. But it has its limitations. The fundamental problem is that while this technique can detect regional changes, it is not able to explain why the changes have occurred. Nor does it take account of how the developments in one industry in a region may spur growth in other industries in the same region, e.g. whether growth in small-scale wood manufacturing firms creates new opportunities for other forest-related activities. It is therefore not possible to predict how active public support can contribute in order to counteract the weakening of the forest industries' position as an income generator, both nationally and not least in many

rural regions. Nevertheless, the results and framework given in this paper should serve as a sound background for future research on these issues.

There are few indications that the restructuring of the forest industry has completed. Continued declines in real prices must still be expected for standard products, including both timber and other forest products. Lower prices for timber and other forest products might, however, create a new and innovative environment for product development and use of raw materials. Also, new market trends are emerging which, if the opportunity is properly seized, can pave the way for increased demand for Norwegian wood. There is growing demand for alternative environmentally friendly materials, special and non-standard products, and Internet trading which allows direct transaction between producer and consumer without going through retail chain outlets. If a region manages to utilise successfully local business networks in combination with formalised knowledge, it might be able to support positive economic progress. For example, adapting production to meet the increased demand for holiday cabins and second homes (due to a general rise in living standards in the larger urban areas) can generate a spin-off effect from economic growth in urban areas in the form of jobs in peripheral regions – and also increased opportunities for utilisation to the forest resources in those regions. These are issues that, in addition to the present study, should serve as a background for quantitative and qualitative studies aiming at gaining greater understanding of the reasons for growth and recession of forest-based industries in rural regions.

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